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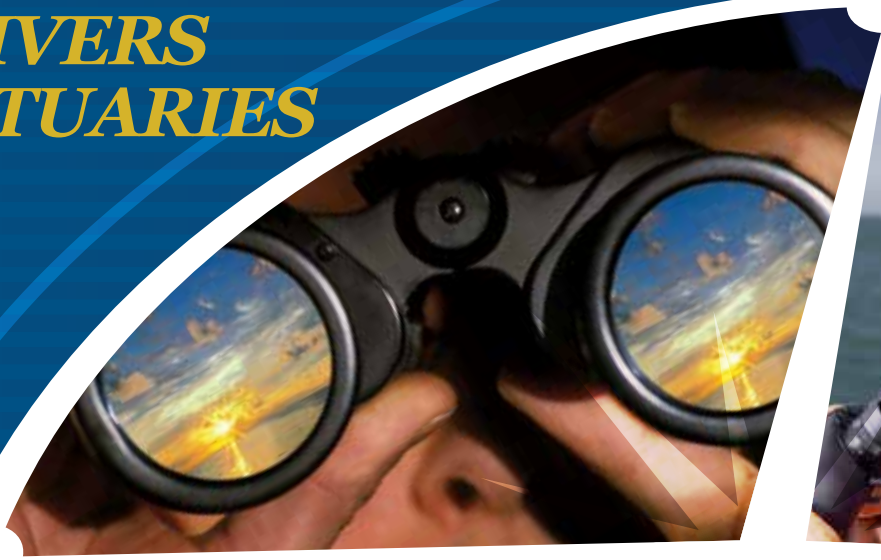
VESSEL HANDLING IN RIVERS AND ESTUARIES



DIGITAL EDITION

Captain Robert L. Figular

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LEARNING SYSTEM™

VESSEL HANDLING IN RIVERS AND ESTUARIES

by Captain Robert L. Figular

Mariners Learning System™
Princeton, New Jersey

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ACKNOWLEDGEMENTS
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Vessel Handling in Rivers and Estuaries

Maneuvering in Rivers

The section provides general information for operating on rivers, with emphasis on the western rivers. The western rivers (Mississippi River system) pose navigational concerns that often are not seen in harbor, coastal, or high seas sailing. Local knowledge is very important. Navigational techniques and the language both have differences that must be learned to become a competent river sailor.

Major Piloting Differences

Some of the special considerations for river navigation include:

- Charts
- Mile marks
- Fixed aids
- Buoyage
- Compass
- DR plot

• Charts

Charts are simple, line drawn "maps" that show the main geographical features of the waterway, the channel or sailing line, prominent man-made objects, and the various aids. River charts do not show landmarks such as stacks, water towers, or antennas. These charts do not always show the geographical names for areas along the bank. River charts only show structures immediately on the banks by symbol and footnote.

• Mile Marks

The Western Rivers have mile marks (beginning at the mouth or at the headwaters of the stream).

• Fixed Aids

Fixed aids (daymarks and lights) display the mile, usually as statute miles, on a "mile" board for that point of the river. Where no aid exists, landmarks such as bridges, creeks, islands, and overhead power lines provide the mile-mark reference.

• Buoyage

The U.S. lateral system of buoyage has differences when used on these rivers.

• Compass

Compasses are not normally very useful on western rivers because there are no plotting references on the chart, and many rivers meander. However, boat-mounted compasses must be installed. There will be situations where the use of a compass can help determine a position. For example, on a meandering river with no prominent landmarks, comparing the compass heading with the north arrow on the chart will help identify the bend or reach where the boat is operating.

• DR Plot

As in coastal sailing, a boat's approximate position is determined by dead reckoning, applying its speed, time, and course from its last known position. However, because many rivers have numerous bends, it often is not possible to maintain a complete DR plot with precise course changes.

Conditions and Effects

Surface and bottom conditions of a river are unpredictable and can change quickly. Some of the unique situations to deal with include:

- Silting and shoaling
- Drift
- Flood or drought

• Silting and Shoaling

Silt is a mass of soil particles carried in water. It can clog boat cooling water intakes and wear out strut bearings and shafts. Silt settles on the bottom as shoaling, either adding to or creating sand bars or mud banks.

• Drift

Drift, or driftwood, is floating debris carried by the river flow and washed or lifted from the banks. Running drift can damage a boat.

- **Flood or Drought**

  Tides affect rivers near the coast, but a flood or a drought will greatly affect the vertical level (depth) of the entire river.

Flood

A flood is created by runoff or drainage from heavy rains or melting snow. Navigating outside the riverbanks requires caution and local knowledge. During a flood condition, some dangers may include:

- Currents are much stronger.
- Channels can shift.
- Obstructions can be hidden under the water.
- Drift hazards (trees and other debris) increase.
- AtoN can be broken.
- Bridge clearances are reduced.

Drought

A drought is low water level. This can result in the closing of channels. Snags and obstructions that once were cleared easily become hazards to navigation. Also, sandbars and mud flats will appear where it was once safe to operate.

Operating in a Narrow Channel

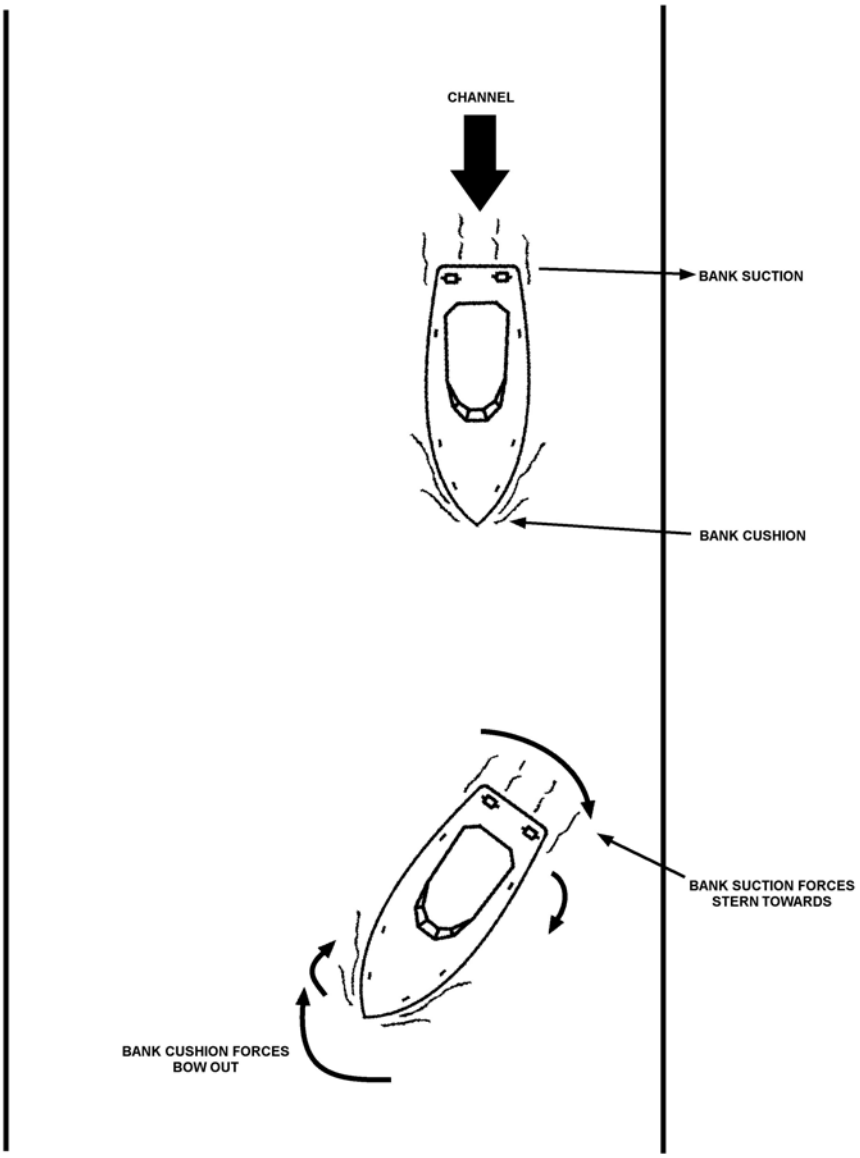
Bank cushion occurs only when operating in close proximity to the bank and refers to a boat being pushed away from the nearest riverbank. As the boat moves ahead in the river, the water between the bow and the near riverbank builds up high on the side of the boat, causing the bow to move away from the bank. The bank cushion effect is especially prevalent if the draft of the boat is nearly equal to the depth of the water, or in narrow channels with steep banks.

Bank suction refers to the stern of a boat being pulled toward the bank. As the boat moves ahead while near the riverbank, the unbalanced pressure of water on the aft quarter lowers the water level between the boat and the bank, forcing the stern to move toward the bank. This suction effect occurs most notably with a twin-screw boat.

The combined effect of bank cushion and bank suction may cause a boat to take a sudden sheer toward the opposite bank.

A single-screw boat going at a very slow speed with its port side near the left bank may lose control if sheer occurs. Increasing speed and adding a small amount of left rudder will bring the boat under control.

A twin-screw boat, with its port side near the left bank, usually recovers from this sheer by increasing speed on the starboard engine and adding left rudder.



Bank Cushion and Bank Suction Effects in a Narrow Straight Channel

• Current

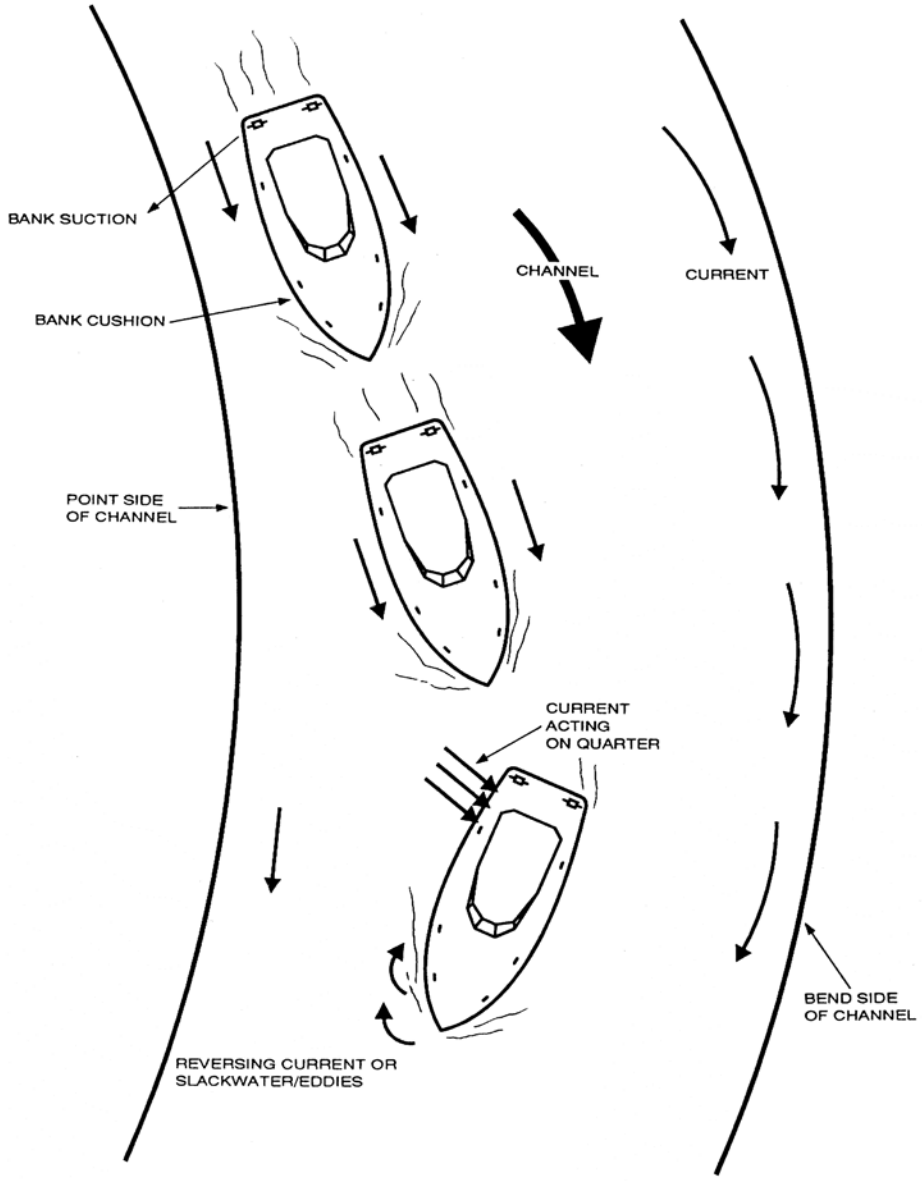
Current is the horizontal flow or movement of water in a river. Maximum current occurs during runoff and/or high water, and the greatest velocity is in the area of the channel. Restricted or narrow channels tend to have a venturi effect, in that rushing water squeezes into a passage and accelerates. Current in a bend will tend to flow away from the inside point (to the outside), creating eddies, counter currents, and slack water immediately past the point. This effect will build shoals at the point or inside a bend. The prudent operator will be alert to the changing current within a waterway.

• Extremely Narrow Channels

In extremely narrow channels where bank cushion and bank suction are expected, the boat operator should proceed at a very slow speed, keeping near the middle of the channel and passing other boats closer than normal. In a meeting situation in a narrow channel, headway should be reduced but not enough to lose steerage. On approaching the boat, a small amount of right rudder should be applied to head slightly toward the bank. Shortly after passing the other boat, the boat operator should reverse the rudder and straighten up. A little right rudder may be needed to hold course against the bank cushion effect. Because of wash from passing boats, extreme caution should be used.

Hugging the Point

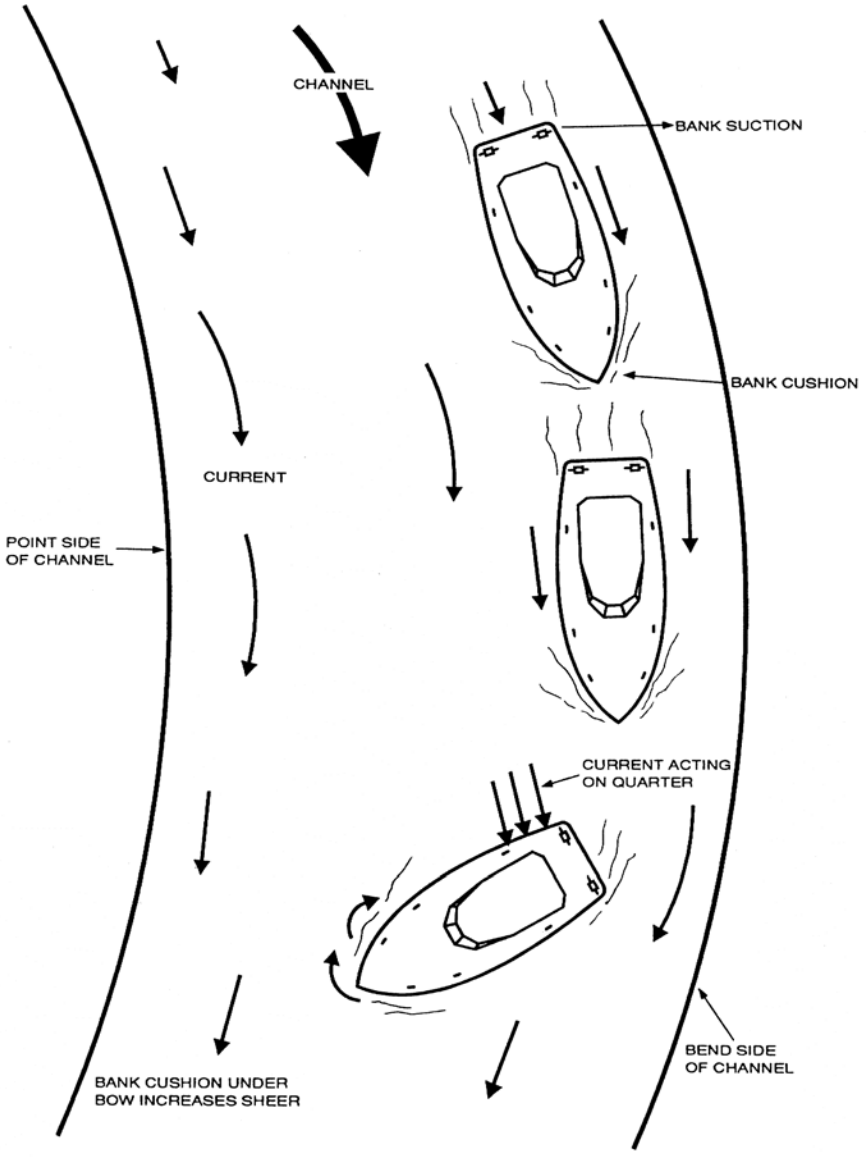
The operator carries a small amount of rudder toward the near bank to steer a straight course. As the channel begins to bend and the boat moves from the bank, less rudder will be necessary. This condition is a signal that it is time to begin the turn. However, slack water or eddies may be around the bend, making it difficult to prevent a sheer toward the near bank, especially in shallow water. The current under the quarter may affect the stern and result in an increase in sheer. To correct for this, the boat operator should apply additional power and rudder to steer back towards the center of the channel, keeping the stern in the middle of the channel.



Hug the Point

Staying in the Bend

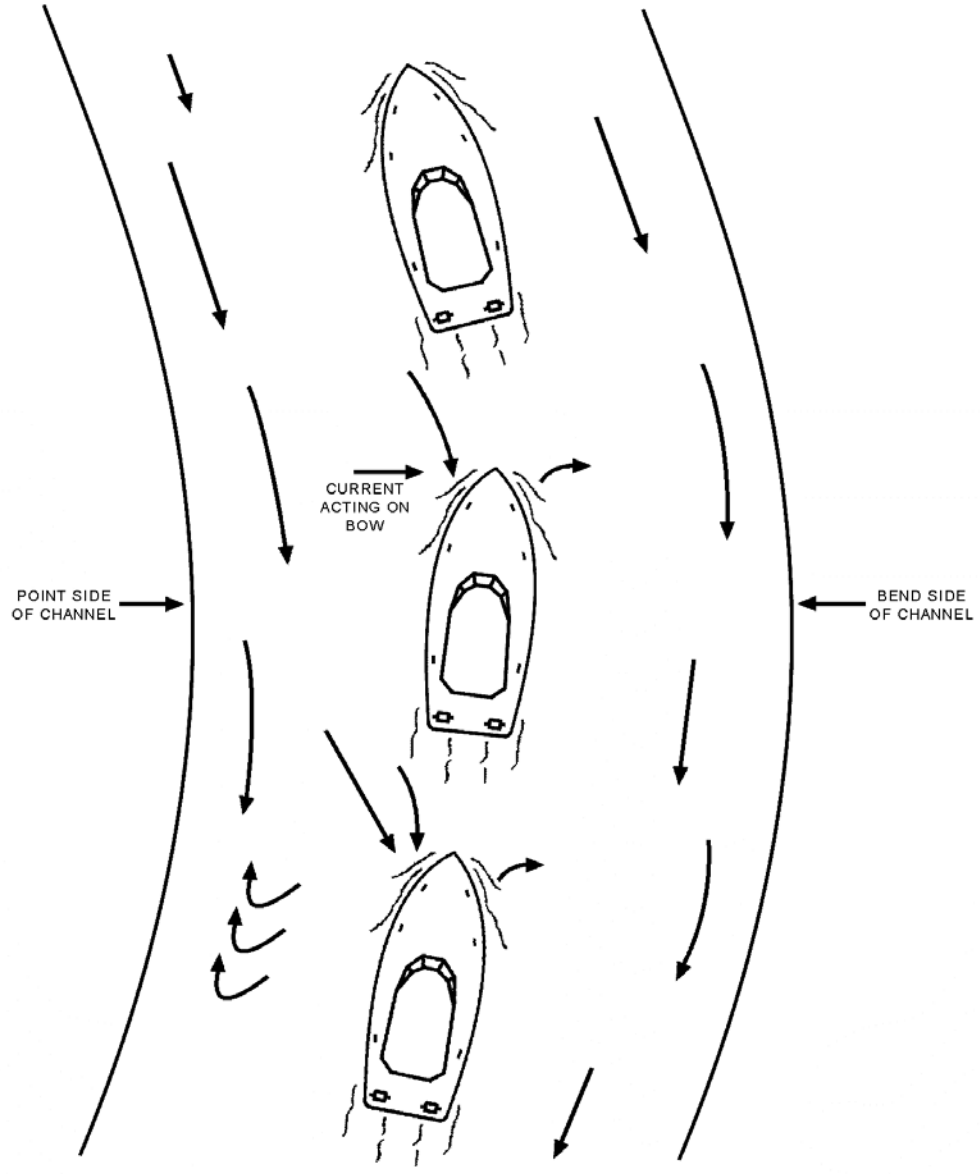
Staying in the bend is a turn in the bend away from the point that takes precise timing. If done too late, the boat may ground on the bank in the bend. If done too soon, there is extreme danger that a strong and sudden sheer will occur. The bank suction on one quarter combines with the current on the other quarter to give the boat the sheer. Also, the bank cushion under the bow will increase the sheer. Again, to correct for this situation, additional power and rudder should be applied to steer back towards the center of the channel.



Stay in the Bend

Head Current

It is always easier to pilot the vessel into the current rather than have the current off the stern. When making a turn into a head current, the boat operator should apply power and rudder as needed to stay in the middle of the channel. Caution should be used when starting a turn. If started too soon, the head current could catch the bow and force the vessel down on the point side of the channel. If this happens, the boat operator should apply power and steer back towards the center of the channel and wait until later in the bend to commence the turn. Care should be taken not to wait too long before starting the turn. If the turn is started too late, the current could catch the bow and push the vessel towards the bend side of the channel. The stern should always be kept in the middle of the channel.



Heading Into Current

Locks and Dams

Locks and dams provide a navigable channel for river traffic. Navigation dams release water, as necessary, to maintain a navigable channel during the navigation season. Locks release water as a part of their normal operation. Both of these can be a safety problem for boats. Knowledge of locks and dams, including location, use, and associated hazards, is essential for safe boat operations.

• Construction and Operation

The navigation dams on the Mississippi, Illinois, and Ohio rivers can be of different construction. Two types of dam construction are the Tainter gate and the Roller gate. Also, some dam releases are controlled remotely. This is the kind of local knowledge that the boat crew needs to check before operating in that area.

Most people know that water released from a dam can create a powerful, turbulent current going downstream. However, upstream water current can exist close to the lower or downstream side of a dam. Operating too close to the downstream side of a dam can result in the boat being drawn into the dam.

A strong suction is created by the rush of water underneath the upper side of a roller-gate dam. A boat drifting into the dam on the upper side may not be in immediate danger on the surface but it is possible for boats to be drawn into the gates. These areas are usually marked by danger buoys upstream of the dam and should be avoided as much as possible. If entering this area is a must, the lockmaster should be contacted before entering. If the boat enters this area, crewmembers should not go into the water.

• Navigation Displays

When locks at fixed dams and moveable dams have their dams up, they will show navigation lights during hours of darkness. These lights are green, red, or amber and in groups of one, two or three. A circular disc may also be shown. The significance of these displays is explained in local guidance.

• Lock Operations

The purpose of a lock is to raise or lower the boat to the level of the channel that it wants to continue to navigate. Locks come in all shapes and sizes, but they all operate on the principle that water seeks its own level. A lock is an enclosure with accommodations at both ends (generally called gates) to allow boats to enter and exit. The boat enters, the gates are closed, and by a system of culverts and valves, the water level in the lock aligns with the pool level of the upstream or downstream side of the lock. The gate then opens and the boat can continue on its way.

Locking Procedures

There are many common locking procedures but local regulations can vary. The boat crew must check local guidance for correct locking procedures of each lock. Precautions to take in locking include:

- Do not come closer than 400 feet of the lock wall until the lockman signals to enter.
- Moor to the side of the lock wall as directed.
- If using own mooring lines, they should be at least 50 feet long with a 12-inch eye splice.
- Do not tie mooring lines to the boat; tend the lines as the water level changes.
- Be prepared to cast off lines in an emergency; a small hand axe or hatchet should be available.
- Use fenders.
- Do not moor to ladder rungs embedded in the lock walls.
- Wait for the lockman's signal (an air horn) to depart.
- Depart in the same order of entering the lock with other boats.
- Steer for the channel and keep a sharp lookout for craft approaching from the other direction.

At locks with "small craft signals," signal the lockman the desire to pass. After signaling, stand clear and wait for instructions. Many locks are radio-equipped. Consult the appropriate navigation charts for radio-equipped locks, their frequency, and call sign.

• General Considerations

General considerations around locks include:

- The Secretary of the Army sets the priorities for safe and efficient passage of the various types of craft on inland waterways. Priorities, listed in descending order with the highest priority on top, are:
  - U.S. military craft
  - Vessels carrying U.S. mail
  - Commercial passenger craft
  - Commercial tows
  - Commercial fisherman
  - Recreational craft
- Under certain conditions, boats may be locked through with other crafts having a higher priority. This occurs only when there is no delay and neither craft is placed in jeopardy.
- Lockmen have the same authority over a boat in a lock as the traffic police have over a car at an intersection. For safety purposes, obey the lockman's instructions.

General Considerations around Navigational Dams

General safety considerations include:

- Stay clear of danger zones, which are 600 feet above and 100 feet below dams.
- Approach dams at reduced speed, along the shore at the lock.
- Be "dam" conscious:
  - During the filling process, it is dangerous to approach the intake ports in the lock walls above the upstream lock gates. The filling process creates a powerful suction as water rushes into the culverts. Boats must stay clear of the locks until signaled to approach.
  - During the emptying process, a strong undercurrent and suction is created in the lock chamber. This suction occurs next to the lock walls and is created by the water rushing into the filling and emptying ports of the lock. Wearing a PFD may not keep a person from being pulled under the water in these circumstances.

Common River Sailing Terms

River Sailing Terms	
Term	**Description**
Auxiliary Lock	A small secondary lock next to the main lock.
Backwater	The water backed up a tributary system.
Bar	A deposit of sand or gravel in or near the channels that, at times, prevents boat traffic from passing.
Bend	A bend of the river, similar to a curve in a highway.
Berm	The sharp definitive edge of a dredged channel, such as in a rock cut.
Bight of a Bend	Sharpest part of a curve in a river or stream.
Bitts, Floating	Part of a lock system for securing a boat waiting in a lock, recessed in lock walls.
Boil	Turbulence in the water resulting from deep holes, ends of dikes, channel changes, or other underwater obstructions.

River Sailing Terms	
Term	**Description**
Caval or Kevel	A steel cleat of special design on barges and towboats for making aft mooring and towing lines.
Chute	Section of river that is narrower than ordinary and through which the river current increases. It is also the passage behind an island that is not the regular channel.
Deadhead	A water soaked wooden pile, tree, or log that floats at the surface of the water (barely awash), usually in a vertical position.
Dike	A structure of pilings or stone that diverts the current of a river.
Down Draft	The natural tendency of a river current to pull the boat downstream when making a river crossing.
Draft	A crosscurrent that is usually designated as an out draft, or as a left- or right-handed draft.
Draw Down	The release of water through one dam before the arrival of a significant increase in water from the upper reaches of the river.
Drift	Debris floating in or lodged along the banks of the river. (Also known as driftwood.)
Flat Pool	The normal stage of water in the area between two dams. It is maintained when little or no water is flowing; therefore, the pool flattens out.
Flood Stage	A predetermined level or stage along the main river bank where flooding will occur or may overflow in the particular area.
Foot of	The downstream end or lower part of a bend or island.
Gauge	A scale graduated in tenths of a foot that shows the water level or river stage. A lower gauge is one that shows the downstream side of a dam and an upper gauge is one on the upstream side.
Head of	The upstream end or beginning of a bend or island.
Left Bank	The left bank of a river when going downstream, properly termed left bank descending.

River Sailing Terms	
Term	**Description**
Levee	An embankment or dike constructed for flood protection.
Lock	A chamber built as part of a river dam to raise or lower boat traffic that wants to pass the dam.
Lock Gate	A moveable barrier that prevents water from entering or leaving a lock chamber.
Mile Board	A 12” x 36” board above a river aid with the river mileage at that point from a given location.
Open River	Any river having no obstructions such as dams, or when the river stage is high enough to navigate over movable dams.
Pool Stage	The stage of water between two successive dams. It is usually at the minimum depth to maintain the depth in the channel at the shallowest point.
Reach	Usually a long, straight section of a river.
Right Bank	The right bank of a river when going downstream, properly termed as right bank descending.
Slack Water	A location where there is a minimum current.
Snag	Tree or log embedded in the river bottom.
Tow	One or more barges made up to be transported by a boat.
Towboat	A riverboat that pushes barges ahead.

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